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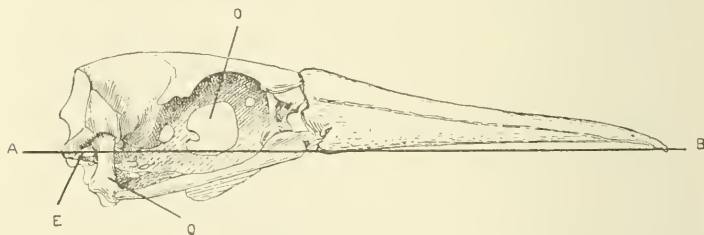
XXVI.—*On the Position of the Ear in the Woodcock (Scolopax rusticula).* By W. P. PYCRAFT, F.Z.S., M.B.O.U.

It has long been known that in the matter of the position of the external aperture of the ear, taken in its relation to the eye, the Snipe (*Gallinago*) differs markedly from all other birds. It appears, however, to have generally escaped the notice of naturalists that this peculiarity was still more marked in the Woodcock (*Scolopax*), wherein the aperture of the ear comes to lie under, and in front of, a line drawn vertically through the anterior canthus of the eyelid and at right angles to the long axis of the beak—the only measurement which can be adopted when the bird is examined in the flesh. This may be called the sportsman's test and the test of the field-naturalist. In the Snipe, it may be remarked, the aperture lies less far forward—under the eye, in short, when measured by the test just described. The still more abnormal position of this aperture in the Woodcock escaped notice, because it was assumed that what obtained in the Snipe would naturally obtain also in the Woodcock. That this, however, is not the case was first discovered, so far as the evidence goes, by my friend Mr. C. Whymper, who induced me to undertake the task of bringing it to the notice of ornithologists, which I did in the columns of 'The Field,' May 18, 1907.

Typically, it may be remarked, this aperture lies at a

considerable distance behind the eye, when a bird is examined in the flesh. But to get to the bottom of this matter, it is necessary to carry the investigation a little deeper—to study the skull, in short. And to properly appreciate the nature of this very remarkable departure from the type which the Snipe and Woodcock exhibit, a survey of the skulls of a few other less specialized birds is necessary. That of the Gannet affords an admirable illustration. Herein attention may first be drawn to the position of the quadrate, behind the articular head of which lies the external auditory aperture (text-fig. 2, E). This bone, then,

Text-fig. 2.



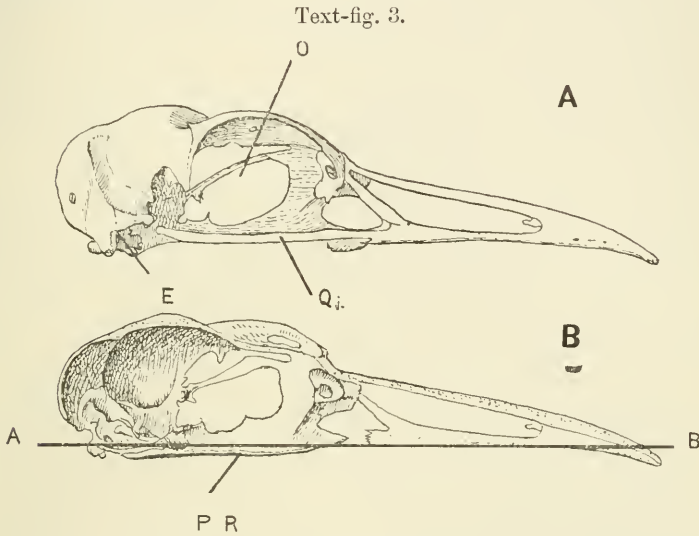
Side view of the skull of a Gannet (*Sula bassana*), shewing the position of the external auditory meatus (E) and the long basicranial axis running parallel with the long axis of the beak, indicated by the line A-B.

O=Orbit. E=Aperture of the ear. Q=Quadrate.

is, as it were, suspended from the extremity of a short flying buttress springing from the hinder portion of the brain-case, almost the whole of which, it will be noticed, lies in front of this buttress; furthermore, it may be remarked that it is roughly cordiform in shape. Very well. Now as to the aperture of the ear. This, it will be seen, is small, lies immediately behind the articular head of the quadrate, and is overhung by a projection from the buttress just referred to—the paroccipital process. Furthermore, it will be noticed, this aperture is far removed from the orbit.

In the Guillemot (text-fig. 3, p. 553) it will be seen that while the shape of the temporal region of the skull agrees roughly with that of the Gannet, it has been brought more

forward, nearer to the orbit, but the aperture of the ear is still far from the hinder border of this cavity. The relative position of the quadrate has also somewhat changed, for while in the Gannet its vertical axis slopes obliquely backwards (caudad), in the Guillemot it has an exactly opposite direction.



A. Outer side of the skull of a Guillemot (*Lomvia troile*), shewing the position of the external auditory meatus (E) and the long basi-cranial axis running parallel with the axis of the beak, indicated by the line A-B in text-fig. B.

O=Orbit. Qj.=Quadrato-jugal bar concealing the lower border of the parasphenoidal rostrum, which is seen in B at P.R.

B. Inner view of the same skull, shewing the form of the brain-case and the basi-cranial axis (A-B).

Turning now to the Oyster-catcher (*Hematopus*), very marked changes in these relations are to be found. Here, it will be noticed, the aperture of the ear has come to lie immediately under the posterior border of the orbit; while the quadrate has its long axis turned forwards. This change has been accompanied by very marked alterations in the form of the cranium, which is almost hemispherical in shape, while the foramen magnum now looks downwards

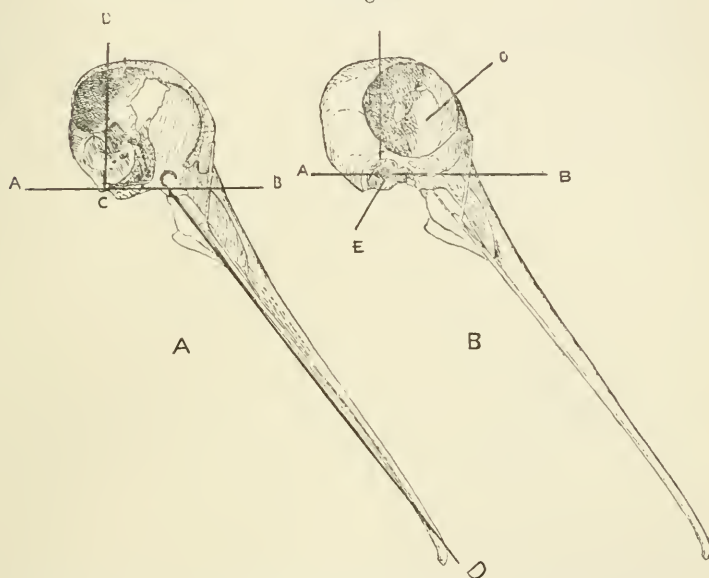
rather than backwards. Furthermore, while in the Gannet this foramen looks directly backwards, and is placed at right angles to the basicranial axis, in the Oyster-catcher it forms an obtuse angle with this axis. But more striking still is the change in the relative position of the brain. In the Gannet the cerebrum and cerebellum lie one in front of the other in a plane parallel with the basicranial axis, but in the Oyster-catcher the brain-cavity has, as it were, rotated through a large segment of a circle, whereby the long axis of the cerebrum has come to be almost at right angles to the long axis of the skull!

In the Snipe all these characters are still further exaggerated, so that now the external aperture of the ear has come to lie just caudad of the middle of the inferior margin of the orbit, while the quadrate is now brought under the very middle of the orbital floor, though its articular surface lies considerably caudad of this area.

The Woodcock (*Scelopax*) forms the culminating point of all these peculiarities, which here attain their maximum development. The skull, in longitudinal section, is almost circular, while the orientation of the cranium (brain-case), through the excessive shortening of the basicranial axis to be described presently, has become profoundly changed. Thereby the long axis of the brain no longer lies in the same horizontal plane as the basicranial axis—that is to say, it no longer lies parallel with this, but forms therewith a right angle (text-fig. 4, p. 555). A line drawn vertically through the middle of the auditory meatus, at right angles to the long axis of the cranium, passes through the posterior third of the orbit, while if this line be drawn at right angles to the long axis of the beak it will pass through the anterior margin of the orbit, which would be in front of a similar vertical line passing through the periphery of the iris (text-fig. 4). Thus, then, if the head of a recently-killed Woodcock be examined, the aperture of the ear will appear in a quite abnormal position, for if a line be drawn at right angles to the long axis of the beak, and passing through the periphery of the anterior margin of the exposed surface

of the eye, the aperture of the ear will be found lying in front of this line. In other words, when examined in relation to the beak as just described, the aperture of the ear appears to lie in front of, and below the level of, the eye. A comparison of text-figs. 4 (A & B) will make this clear.

Text-fig. 4.



- A. Inner view of the left half of the skull of a Woodcock (*Scolopax rusticula*), shewing the brain-case and the relation thereof to the basicranial axis.

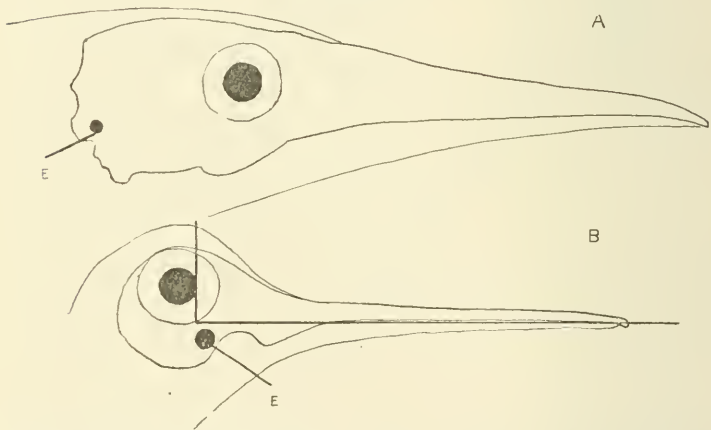
The line A-B=a line drawn through the basicranial axis; the line C-D=a line drawn from the occipital condyle through the brain-case, at right angles to the basicranial axis. This figure is not quite accurately drawn, hence this line passes too far to the left; its true position is indicated by the short line to the right of C-D.

- B. Outer view of the same skull, shewing the relation of the external aperture of the ear (E) to the basicranial axis (A-B). O. Orbit.

In the Snipe this aperture is less forward in position, but it is still markedly different in this relation to what obtains in other birds, since here it appears to open immediately beneath the eye.

Although this shifting of the external aperture of the ear in relation to the orbit has not been accompanied by such profound structural changes as a superficial comparison of this aperture between, say, a Gannet and a Woodcock (text-fig. 5, A & B) might lead one to expect, yet, as a matter of fact, this shifting is associated with very striking skeletal modifications, and these, as we have already indicated, are mainly confined to the cranium. The disturbing factor is apparently the shortening of the basicranial axis. This

Text-fig. 5.



- A. Diagrammatic side view of the head of a Gannet, shewing the outline of the skull and the position of the external aperture of the ear (E) and eye.  
 B. Similar view of the head of a Woodcock, to shew the forward position of the ear.

interpretation was first given by Prof. D'Arcy Thompson in an article in 'The Field,' Nov. 16, 1907 (vol. 110, p. 887). Therein, however, the extent of the changes in the conformation of the Woodcock's skull were unduly minimized, for the author sought to shew that, while in a skull such as that of the Guillemot the long axis of the cranium was parallel with that of the upper jaw, in the Woodcock these two axes formed almost a right angle with each other—to be quite precise, about  $70^{\circ}$  (text-fig. 3).

Prof. D'Arcy Thompson sought, as we have remarked, to

shew, by constructing various angles, in how little the skull of the Woodcock really differed from that of other birds; and thereby he has obscured some really striking facts in regard to these changes which have been brought about in the form of the cranium and its relation to the beak, to which we shall return presently. The outline diagrams (text-fig. 5, A, B) of the skulls of the Gannet and Woodcock will shew at a glance the relative changes of position between the aperture of the ear and the eye, while in text-figs. 3 and 4 the changes in the form of the brain-case are no less strikingly demonstrated. Thus, in the Gannet a line through the occipital condyle at right angles to the basicranial axis of the skull passes through the foramen magnum—that is to say, passes out behind the brain-case; but a similar line through the occipital condyle of the Woodcock passes through the middle of the brain-case!

And now as to the relation of the beak to the long axis of the cranium. In the more primitive skulls—as, for example, in the Gannet and Guillemot—the basicranial axis and the long axis of the beak run parallel one to another, while in the Woodcock the long axis of the beak runs almost at right angles to the basicranial axis. By the shortening of this axis the cranium has become tilted backwards, or, more correctly, as the base of the cranium shortened the foramen magnum was brought nearer the base of the beak, thereby throwing the floor of the metencephalic fossa into a vertical position, and bringing the cerebellar fossa into such a position that it now lies beneath, instead of behind, the cerebral fossa—a truly remarkable case of shifting parts.

#### SUMMARY.

Prof. D'Arcy Thompson, in the article to which reference has already been made, remarks: "The Woodcock's ear is very little, if at all, out of its normal place when looked at in relation to the base, or hinder part of the skull. In other words, it is not the Woodcock's ear, but its bill that is abnormally situated." But the weight of evidence, it seems

to me, points entirely to an opposite conclusion. The cranium of the Woodcock, when compared with that of the Gannet, for example, has obviously undergone very profound modifications, and these have come about by what may be described as a process of telescoping the basis cranii; thereby the brain-cavity has completely changed its shape, and the aperture of the ear with the rest of the hinder portion of the cranium has been swung downwards and forwards towards the base of the beak, the long axis of which virtually retains its primitive angle. This being so, and the evidence is incontrovertible, it is not the beak which is abnormally situated but the aperture of the ear, as I originally contended. Furthermore, let me repeat once more, the ear of the Woodcock is *not* "just under the eye" as in the Snipe, as was contended by a writer in 'The Field' for Sept. 7, 1907 (vol. 110, p. 479).

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XXVII.—*Observations regarding the Breeding-Seasons of the Birds in Southern Kamerun.* By G. L. BATES, C.M.Z.S., M.B.O.U.

(Plate XI.\*)

WITH reference to our northern birds, we are so accustomed to the facts that they nest and breed at a certain time of the year, moult at another, and migrate (in many cases) at a third, that it is hard to realize a state of things in which there is no such regular observance of seasons among birds. On coming to the tropical forest-country of West Africa the ornithologist expects to find breeding- and moulting-seasons among the birds. The assumption that they have such seems to underlie the published accounts of different

\* This map has been prepared to shew the localities of the places mentioned by Dr. Bowdler Sharpe and myself in this and former papers on the Birds of Southern Kamerun. See 'Ibis,' 1904, pp. 88, 591; 1905, pp. 89, 461; 1907, p. 416, and 1908, pp. 117, 317. It will be observed that some of the inland places are in the water-basin of the Congo.—G. L. B.